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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/700,236	05/09/2001	Xiong Zhang	83973/269224	3694

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EXAMINER	
SONG, MATTHEW J	

ART UNIT	PAPER NUMBER
1722	

DATE MAILED: 12/28/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	09/700,236	ZHANG ET AL.
	Examiner	Art Unit
	Matthew J. Song	1722

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11 October 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-14* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-14* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

2. Claims 1-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakamura (US 5,290,393) in view of Tischler et al (US 5,679,152) and Tischler et al ("Defect Reduction in GaAs epitaxial layers using GaAsP-InGaAs strained layer superlattice").

Nakamura teaches forming a buffer layer of $Ga_xAl_{1-x}N$ on a substrate at a first temperature and forming an epitaxial layer of a gallium nitride based compound on the buffer at a second temperature (col 4, ln 1-10). Nakamura also teaches AlN, which is grown at a low temperature, is a polycrystalline layer and when the temperature of the substrate is increased to about 1000°C in order to form GaN (col 4, ln 40-55), the polycrystalline layer partially becomes

monocrystalline, this reads on applicant's intermediate buffer layer partially recrystalizes at said temperature. Nakamura also teaches the temperature of epitaxial growth is 900-1150°C and the temperature for the polycrystalline buffer layer is 200-900°C (col 5, ln 50-60 and col 6, ln 15-25). Nakamura also teaches forming a p-type or n-type GaN epitaxial layer (col 6, ln 1-15). Nakamura also teaches growing the buffer layer and the epitaxial layer using MOCVD (col 1, ln 1-67 and Example 1).

Nakamura teaches forming a single buffer layer. Nakamura does not teach forming a MOCVD periodic or non-periodic amorphous or polycrystalline intermediate multi-layered buffer having at least three layers with each layer having a thickness in the range of 2nm-6nm on a substrate in which the layers alternate between at least two types of compound semiconductors A and B different from each other in lattice constant, energy band gap, layer thickness and composition.

In a method of making GaN single crystals, Tischler et al teaches dislocations araisng from lattice mismatch are reduced in GaN layers by using buffer layers which may be a single compound, a compositionally graded layer structure or a superlattice structure comprising alternating layers A and B, where A and B are selected from GaN, AlN, and InN and alloys of SiC with these nitrides, this reads on applicant's A and B different in lattice constant, energy band gap and composition. Tischler et al also teaches the strained superlattice can comprise 5 to 200 alternating A and B layers. Tischler et al also teaches by using such superlattices, it is possible to force misfit dislocations to the edge of the substrate instead of permitting them to propagate up into the growing layer and such superlattice buffer layers have been characterized previously (col 4, ln 1-67). It would have been obvious to a person of ordinary skill in the art at

the time of the invention to modify Nakamura by using a superlattice buffer, as taught by Tischler et al, to reduce lattice mismatch by forming misfit dislocations to the edge of the substrate.

The combination of Nakamura and Tischler et al does not teach the thickness of each layer is 2 nm to 6 nm and layers A and B have a different thickness.

In a method of defect reduction in epitaxial layers using superlattices, Tischler et al teaches a superlattice is constructed of layers with different lattice constants such that layers are alternately under compression and tension. Tischler et al also teaches the layers are thinner than a maximum thickness such that the strain in accommodated elastically, but greater than a minimum thickness required for "bending over" the dislocations, this is a teaching that the thickness of the layers of the superlattice are result effective variables. Tischler et al also teaches a ten period superlattice buffer (SLB) grown using MOCVD at a growth temperature of 630°C. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Nakamura and Tischler et al ('152) by optimizing the thickness of each layer of the superlattice, as taught by Tischler et al to obtain different thickness of each layer between 2 and 6nm to prevent dislocation propagation from the substrate.

Referring to claim 2, the combination of Nakamura, Tischler et al ('152) and Tischler et al teaches a p-type or n-type epitaxial layer ('393 col 6, ln 1-10).

Referring to claim 3-4, the combination of Nakamura, Tischler et al ('152) and Tischler et al teaches using MOCVD to grow the buffer layers ('393 Example 1 and Tischler pg 294).

Referring to claims 5 and 11, the combination of Nakamura, Tischler et al ('152) and Tischler et al teaches using GaN, AlN and InN.

Referring to claim 6, the combination of Nakamura, Tischler et al ('152) and Tischler et al teaches a sapphire substrate ('152 col 2, ln 40-50 and '393 Example 1).

Referring to claim 7, the combination of Nakamura, Tischler et al ('152) and Tischler et al teaches the polycrystalline buffer is formed at 200-900°C ('393 col 6, ln 10-25 and Tischler pg 294).

Referring to claims 8, 13 and 14, the combination of Nakamura, Tischler et al ('152) and Tischler et al does not teach the thickness of 24 nm and 3 period of AB units or the buffer thickness is less than 48 nm or 96 nm. The thickness of each buffer layer and the total buffer layer thickness is well known in the art to be a result effective variable, as evidenced by Nakamura (col 5, ln 45-55) and Tischler et al (pg 294). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Nakamura, Tischler et al ('152) and Tischler et al by optimizing the thickness of the superlattice buffer by conducting routine experimentation of a result effective variable to obtain the claimed thickness. Furthermore, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation. (In re Aller, 220 F.2d 454, 456, 105 USPQ 233, 235(CCPA 1955)).

Referring to claims 9-10, the combination of Nakamura, Tischler et al ('152) and Tischler et al teaches GaN, AlN or InN ('152 col 4, ln 35-50).

Response to Arguments

3. Applicant's arguments, see page 2 of the remarks, filed 10/11/2005, with respect to the 112 first paragraph rejection have been fully considered and are persuasive. The rejection of claims 1-14 has been withdrawn.

4. Applicant's arguments filed 3/25/2005 have been fully considered but they are not persuasive.

Applicant's argument that Tischler does not teach amorphous or polycrystalline layers is noted but is not found persuasive. Tischler is silent to the crystallinity of the strained superlattice buffer. Nakamura teaches a polycrystalline buffer layer of $Ga_xAl_{1-x}N$ ($0<x\leq1$) is formed at a temperature between 200 and 900°C because if the temperature is higher than 900°C, the buffer layer becomes monocrystalline and therefore no longer performs functions as a buffer layer (Abstact and col 4, ln 1-68). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to from the superlattice buffer taught by Tischler using amorphous or polycrystalline layers so that superlattice buffer can function as a buffer, as taught by Nakamura. The use of amorphous or polycrystalline layers in a buffer would have been obvious to a person of ordinary skill in the art in view of Nakamura.

Applicant's arguments that the prior art does not teach the claimed thickness is noted but is not found persuasive. The prior art merely teaches a preferred embodiment for a As based superlattice buffer. Tischler teaches the layers are thinner than the maximum thickness such that the strain is accommodated elastically, but greater than a minimum thickness required for "bending over" the dislocations (pg 294), which is a teaching that the thickness is a result effective variable. Therefore, it would have been obvious to a person of ordinary skill in the art

at the time of the invention to modify the combination of Nakamura and Tischler by optimizing the thickness by performing routine experimentation of a result effective variable. Furthermore, Tischler teaches using monolayer; therefore thickness of 2-6 nm would have been in the range of thickness that would have been obvious to a person of ordinary skill in the art.

Applicant's argument that Tischler does not teach a polycrystalline buffer, but instead teaches a superlattice which is a different structure and formed at a higher temperature for a given material is noted but is not found persuasive. Tischler does not teach forming a superlattice buffer at a higher temperature. Tischler ('152) does not teach any temperature for forming a superlattice buffer. Tischler (Applied Physics Letters) does not require a specific crystallinity. Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to form amorphous or polycrystalline layers in view of Nakamura, as discuss previously.

Conclusion

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J. Song whose telephone number is 571-272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Duane Smith can be reached on 571-272-1166. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Matthew J Song
Examiner
Art Unit 1722

MJS
December 21, 2005

ROBERT KUNEMUND
PRIMARY PATENT EXAMINER
A.U. 1722